### Monday, May 17, 2021

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Midwest Dynamics and Group Actions</strong> -- David Fisher (Indiana University) <em>Totally geodesic submanifold, superrigidity and arithmeticity</em> -- Virtual</td>
</tr>
</tbody>
</table>

### Wednesday, May 19, 2021

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:00pm-5:00pm</td>
<td><strong>Special Events</strong> -- Yuchen Liao (UM) <em>Dissertation Defense: Topics in interacting particle systems and random Schrödinger operators</em> -- Virtual</td>
</tr>
</tbody>
</table>

### Thursday, May 20, 2021

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00pm-4:00pm</td>
<td><strong>Special Events</strong> -- Can Chen (UM) <em>Dissertation Defense: Multilinear Control Systems Theory and its Applications</em> -- Virtual</td>
</tr>
<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Arithmetic Geometry Learning</strong> -- Alex Perry () <em>Applications of the decomposition theorem</em> -- East Hall</td>
</tr>
</tbody>
</table>
Midwest Dynamics and Group Actions  
Monday, May 17, 2021, 4:00pm-5:00pm  
Virtual  
David Fisher (Indiana University)  

Totally geodesic submanifold, superrigidity and arithmeticity

I will discuss some recent work showing that finite volume real and complex hyperbolic manifolds having infinitely many maximal totally geodesic submanifolds are arithmetic. I will put this in the context of what we do and (mostly) don't know about real and complex hyperbolic manifolds, particularly in dimension at least 4. Key ingredients in the proofs depend on homogeneous dynamics and algebraic dynamics and it is tempting to believe these might be relevant to some remaining mysteries. This is based on joint work with Bader, Miller and Stover and also some earlier joint work with Lafont, Miller and Stover.

Zoom link: https://iu.zoom.us/j/661711533?pwd=RTFVTjMrQ1pYTCtIZzIvVGVvODV2QT09
password is 076877 if needed.
In this dissertation, we study some large probabilistic systems with strong correlations mainly coming from mathematical physics. The dissertation is split into two main parts.

The first part is about the totally asymmetric simple exclusion process (TASEP) which is a default probabilistic model for one-dimensional traffic transport. It also serves as a prototypical example among the so-called Kardar-Parisi-Zhang universality class consisting of a large class of strongly correlated random systems modeling random interface growth.

TASEP has a rich algebraic/combinatorial structure which leads to exact formulas for the joint distributions (the study of such probabilistic systems with rich algebraic structures is known as integrable probability). We will explain how the multi-point space-time joint distributions of TASEP (and some variants) can be derived using techniques from combinatorics (symmetric functions), quantum integrable systems and complex analysis. We will also study the large-scale long-time behaviors of such systems and they exhibit interesting phase transitions when we introduce certain inhomogeneity.

The second part is about random Schrödinger operators (RSOs) describing quantum evolutions in disordered media. We will mainly focus on the behaviors of the spectra of RSOs under spatial conditioning (i.e., what can we say if we know some partial information of the spectrum). In particular, a property known as the number rigidity is established for the eigenvalue point processes of a large class of RSOs. Number rigidity roughly states that the total (random) number of eigenvalues inside any bounded set is a deterministic function of the eigenvalue configurations outside of the bounded set. The main tools we use are probabilistic representations of a special class of exponential linear spectral statistics which is related to the semigroups associated with the RSOs and their traces.

Yuchen's advisors are Jinho Baik and Raj Rao Nadakuditi.

Zoom: https://umich.zoom.us/j/91480393821
Passcode: 569413
Special Events
Thursday, May 20, 2021, 2:00pm-4:00pm
Virtual
Can Chen (UM)
Dissertation Defense: Multilinear Control Systems Theory and its Applications

In biological and engineering systems, structure, function and dynamics are highly coupled. Such multiway interactions can be naturally and compactly captured via tensor-based representations. Exploiting recent advances in tensor algebraic methods, we develop novel theoretical and computational approaches for data-driven model learning, analysis and control of such tensor-based representations. In one line of work, we extend classical linear time-invariant (LTI) system notions including stability, reachability and observability to multilinear time-invariant (MLTI) systems, in which the state, inputs and outputs are preserved as tensors, and express these notions in terms of more standard concepts of tensor ranks/decompositions. We also introduce a tensor decomposition-based model reduction framework which can significantly reduce the number of MLTI system parameters. In another line of work, we develop the notion of entropy for uniform hypergraphs, which can capture higher order interactions between entities than classical graphs. We show that this tensor entropy is an extension of von Neumann entropy for graphs and can be used as a measure of regularity for uniform hypergraphs. Moreover, we employ uniform hypergraphs for studying controllability of high-dimensional networked systems. We propose another tensor-based multilinear system representation to characterize the multidimensional state dynamics of uniform hypergraphs, and derive a Kalman-rank-like condition to identify the minimum number of control nodes needed to achieve full control of the whole hypergraph. We demonstrate these new tensor-based theoretical and computational developments in a variety of biological and engineering examples.

Can's advisors are Tony Bloch and Indika Rajapaske.

Zoom - https://umich.zoom.us/j/91237438790
Passcode: 456865

Arithmetic Geometry Learning
Thursday, May 20, 2021, 4:00pm-5:30pm
East Hall
Alex Perry ()
Applications of the decomposition theorem